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Surgical Treatment of Giant Cell Tumor in Proximal End of Tibia by Curettage and Bone Cement

Elsayed Eletawy Soudy, Mohsen Fawzy Omar,
Mohamed Ismael Abd-Elrhman Kotb, Mohammed Basheer Tahir Wail
Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Egypt
***Corresponding author:** Mohammed Basheer Tahir Wali, **E-Mail:** mohammedwali2886@gmail.com

ABSTRACT

Background: A giant cell tumor of bone (GCTB) is a primary bone tumor with potential invasion, local recurrence, and low probability of distant metastasis. Surgical treatment stills the most effective treatment for this kind of tumor. The surgery often involves defect reconstruction following tumor removal.

Objective: Aim of the current work was to evaluate the results of surgical treatment of giant cell tumor in proximal end of tibia by curettage and bone cement.

Patients and methods: This study included a total of eighteen adult patients with giant cell tumor of proximal end of tibia, attending at Department of Orthopedic, Zagazig University Hospitals. Patients were treated by curettage and bone cement. This study was conducted between January 2020 to March 2021.

Results: In this study the age was (30.39±6.4) years ranged from 22 to 41 years, half of the group (50.0%) had age less than 28 years and the other half were equal or more than 28 years. Two thirds (66.7%) of the studied group were females and one third (33.3%) of them were males (2:1). Concerning campanacci radiological grading of lesion; most of the studied group (83.3%) had campanacci grade I and grade II (16.7%). The functional outcome by the musculoskeletal tumor society functional scoring system (MSTS) in the present study revealed that two thirds (66.7%) of the studied group didn't have pain and only (33.3%) of them had intermediate pain.

Conclusion: It could be concluded that patients with GCT of the bone at the proximal end of tibia can be treated satisfactorily with curettage and bone cement packing with lower recurrence rate. Better MSTS functional results were also observed after extended curettage and bone cement.

Keywords: Surgical Treatment, Giant Cell Tumor, Tibia by Curettage and Bone Cement.

INTRODUCTION

Giant cell tumors (GCTs) represent 5% of primary bone tumors. GCT of the bone is a benign but locally aggressive tumor with a relatively high recurrence rate after primary treatment. GCTs mainly occur between the age of 20 and 40 years. Epiphyseal regions of the long bones are the most commonly affected, especially the distal femur and proximal tibia [(1)].

Pain is the leading symptom relating to the mechanical insufficiency resulting from the bone destruction. A soft tissue mass or bump can occasionally be seen and results from the cortical destruction and tumor progression outside bone. GCT is often found close to the joint thus limited range of motion is common, joint effusion and synovitis are also possible. At diagnosis, approximately 12% of patients with GCT present with pathologic fracture [(2)].

Radiologically, GCT of bone has characteristic radiolucent, geographic appearance with a narrow zone of transition found at the margin of the lesion. This margin, contrary to that of many other benign lesions, lacks a complete sclerotic rim. Typically, there is no visible mineralization within the tumor matrix. The lesion is eccentrically located in the metaphysis of long bones usually about the subchondral bone. Moreover, it commonly breaks through the cortex [(2,3)].

GCT of bone typically shows as an epiphyseal, eccentric, expansive lytic lesion with a 'soap-bubble appearance. MRI is useful to assess extra-cortical spread and intramedullary extension [(4)].

Surgical removal of the lesion remains the only curative intent treatment for GCT of the bone. The most common form of surgical treatment for GCT of the bone is aggressive local curettage with or without packing of the defect with bone cement or bone graft and internal fixation. More aggressive surgical approaches employing wide resection of the involved bone may be chosen to achieve tumor removal and potentially decrease the risk of local recurrence, at the cost of greater functional compromise [(5)].

The aim of the current work was to evaluate the results of surgical treatment of giant cell tumor in proximal end of tibia by curettage and bone cement.

PATIENTS AND METHODS

This clinical trial study included a total of eighteen adult patients with giant cell tumor of proximal end of tibia, attending at Department of Orthopedic, Zagazig University Hospitals. This study was conducted between January 2020 to March 2021.

Ethical consent:

An approval of the study was obtained from Zagazig University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of

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the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria:

1. Age group from 20 years to 50 years.
2. Patients without pathological fractures.
3. All patients were diagnosed with giant cell tumor of proximal end of tibia using radiological and laboratory examinations, including X-ray, MRI and histopathology.
4. Lesion did not reach the articular surface of the knee joint.
5. Campanacci radiological grade (I) and grade (II).

Exclusion criteria:

1. Grade III GCTs in association with severely damaged bone structure and soft tissue extension.
2. Pathological fracture.
3. Intra-articular lesion.
4. Patients with other comorbid conditions not fit for any surgical procedure.
5. Recurrent cases.

Preoperative assessment:

All the patients suspected of having giant cell tumor at proximal end of tibia were subjected to history taking, physical examination and investigations for staging of the bone tumor according to the following sheet:

I. History:

- **Personal history:** Age, sex, occupation, address
- **History of present illness:** Pain: (site, character, what ↑? and what ↓?, radiation, onset, course, duration), swelling, pathological fracture, and symptoms of other systems:
- **Past history:** Irradiation, chemotherapy, surgery.
- **Family history.**

II. Examination:

General: General condition and body built.

Local:

-For the suspected swelling:

- Site - Size - Shape - Surface - Skin over.
- Tenderness - Relation to the surrounding structures – Consistency.

-For the distal part of the limb: Any evidence of neurovascular compromise.

III-Investigations:

A) Prebiopsy investigations: Plain X ray, CT scan on the tumor, CT scan on the chest, MRI, and laboratory tests.

B) **Biopsy:** Closed percutaneous tissue core biopsy (CT guided) was done in all cases.

Staging:

After completion of the investigations, staging of the tumor was done using Campanacci's radiological grading method as follows: **Grade I:** tumors were intraosseous lesions. **Grade II:** tumors were intraosseous lesions without loss of cortical continuity and with a thin cortex. **Grade III:** tumors were extra osseous lesions that broke through the cortex and extended into soft tissue.

Operative procedure: The twelve (12) patients have giant cell tumor in medial condyle of proximal tibia which opened by medial approach and other six (6) patients have giant cell tumor in the lateral condyle of proximal tibia which opened by Anterolateral approach.

Closure and Postoperative Care: Subfascial drains were placed which exit in-line with the incision and the Fasciocutaneous flaps were pulled and closed. The limb was kept elevated and in full extension using a posterior splint. The suction drain was removed at the 24-hour drainage was reduced to less than 50cc. The sutures were removed 2 weeks post-operatively.

Statistical analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

Table (1) shows that the age of the studied group was (30.39±6.4) years ranged from 22 to 41 years, half of the group (50.0%) had age less than 28 years and the other half were equal or more than 28 years. Two thirds (66.7%) of the studied group were females and one third (33.3%) of them were males.

Table (1): Age distribution of the studied group:

Variable	The studied group(18) Mean ± SD (Range) Median	
Age (years):	30.39±6.4 (22-41) 28	
Variable	**NO (18)**	**%**
Age grouping < 28 years ≥ 28 years	 9 9	 50.0% 50.0%
Sex Male Female	 6 12	 33.3% 66.7%

Table (2) shows that (66.7%) of the studied group had the lesion at the medial condyle of the proximal end of the tibia opened by medial approach, while (33.3%) had the lesion on the lateral proximal tibial condyle opened by anterolateral approach. 55.6% of the studied group were right sided affected and (44.4%) of them were left sided. 100.0% of the studied group had extended curettage. The most of the studied group (83.3%) had campanacci grade I and grade II (16.7%). Most of the studied group (88.8%) underwent cement &hydrogen peroxide and (11.2%) underwent cement, hydrogen peroxide & internal fixation.

Table (2): Site, side affected, type of resection, companaccis radiological grading of lesion and reconstruction type among the studied group:

Parameters	NO (18)	%
Site: Medial condyle Lateral condyle	 12 6	 66.7% 33.3%
Side affected: Right Left	 10 8	 55.6% 44.4%
Type of resection: Extended curettage	18	100.0%
Grades of lesion: Grade I Grade II	 15 3	 83.3% 16.7%
Reconstruction type: Cement & hydrogen peroxide Cement, hydrogen peroxide & internal fixation	 16 2	 88.8% 11.2%

Regarding walking ability, two thirds of them (66.7%) had unlimited walking ability and (33.3%) had limited ability. More than two thirds of the studied group (77.8%) had normal gait and (22.2%) had intermediate gait **Table (3)**.

Table (3): The functional outcome by the musculoskeletal tumor society functional scoring system (MSTS) among the studied group:

MSTS Score	Variables	NO(18)	%
Pain intensity (10 points VAS analogue)	No	12	66.7%
	Intermediate	6	33.3%
Function	No restriction	8	44.4%
	Intermediate restriction	10	55.6%
Emotional acceptance	Enthused	18	100.0%
	Intermediate	0.0	0.0%
Supports	None	17	94.4%

	Intermediate	1	5.6%
Walking ability	Unlimited	12	66.7%
	Intermediate	0.0	0.0%
	Limited	6	33.3%
Gait	Normal	14	77.8%
	Intermediate	4	22.2%

Regarding pain intensity, this table shows that two thirds (66.7%) of the studied group didn't have pain and only (33.3%) of them had intermediate pain. Concerning function, about half (55.6%) of the studied group had intermediate restriction and (44.4%) didn't have any restriction, (100.0%) of them had enthused emotional acceptance and most of them (94.4%) didn't need any support.

Table (4): The total score musculoskeletal tumor society functional scoring system (MSTS) among the studied group:

Final outcome	The studied group (18)	
	Mean ± SD	(Range)
Post-operative MSTS	28.2 ± 0.87	(26-29)
Percentage	93.4% (86%-96%)	

This table shows that post-operative musculoskeletal tumor society functional scoring system (MSTS) was (28.2 ± 0.87) ranged from (26 to 29) with 93.4%.

Table (5): Complications distribution among the studied group:

Complications	NO(18)	%
No	16	88.9%
Superficial Infection	2	11.1%

This table shows that most of the studied group (88.9%) didn't have any complications and (11.1%) of them had superficial infection.

DISCUSSION

This clinical trial study included 18 patients underwent surgical treatment of giant cell tumor in proximal end of tibia by curettage and bone cement at orthopedic department, Zagazig University Hospitals**.** Their age was (30.39±6.4) years ranged from 22 to 41 years, half of the group (50.0%) had age less than 28 years and the other half were equal or more than 28 years. Two thirds (66.7%) of the studied group were females and one third (33.3%) of them were males (2:1). Concerning campanacci radiological grading of lesion; most of the studied group (83.3%) had campanacci grade I and grade II (16.7%).

All (100.0%) of the studied group had primary lesion at the proximal end of the tibia underwent extended curettage with cement & hydrogen peroxide as adjuvant and 2 patient (11.2%) needed internal fixation in addition.

The functional outcome by the musculoskeletal tumor society functional scoring system (MSTS) in the present study revealed that two thirds (66.7%) of the studied group didn't have pain and only (33.3%) of them had intermediate pain. Concerning function, about half (55.6%) of the studied group had intermediate restriction and (44.4%) didn't have any restriction, (100.0%) of them had enthused emotional acceptance and most of them (94.4%) didn't need any support.

Regarding walking ability, two thirds of them (66.7%) had unlimited walking ability and (33.3%) had limited ability. More than three quarters of the studied group (77.8%) had normal gait and (22.2%) had intermediate gait. With functional scoring system (MSTS) (28.2 ± 0.87) ranged from (26 to 29), with mean percentage of 93.4%. The recurrence rate was zero (0.0%) after a follow up time (11.2±1.04) months ranged from 9 to12 months. Most of the studied group (88.9%) didn't have any complications and only 2 patients (11.1%) had superficial infection.

The results of the current study agreed with **Lackman *et al.* [6] and Vander and Lachman [7]** who advocated that curettage and bone cementing in GCTs, with minimal cortical perforation with 0 and 6% recurrence rates, respectively**.**

Von Steyern *et al.* [8] were in consistent with our findings who retrospectively studied local recurrence of giant cell tumor in long bones following treatment with curettage and cementing in 137 patients. Their mean age at diagnosis was 35 years (15 to 73) for the whole group and 31 years (15 to 73) for those patients who developed local recurrence. The tumors were distributed mainly in the distal femur (n = 53; 39%) and proximal tibia (n = 42; 31%), followed by the distal radius (n = 15; 11%).

In all cases the tumors developed around the knee with almost equal involvement of the distal part of the femur (17 out of 38) and the proximal part of the

tibia (21 out of 38). None of these tumors extended across the knee joint.

Group 1 included 21 patients with a bone cement filling and additional osteosynthesis after curettage. Group 2 included 17 patients of which 10 were treated with curettage and filling with cancellous bone and 7 were treated with curettage alone. 16 patients from group 1 and only 3 patients from group 2 had fully documented clinical examination results as far as joint function for the 1½ years following the operation follow-up period was concerned [9].

Four out of the 14 male patients (28.5%) and 10 out of the 24 female patients (41.5%) showed a local recurrence. The recurrence rate in all patients was 36.8%. The average time to recurrence was two years (range 5 months to 6 years). Six of the patients had a recurrence in less than two years. In 59% of the patients with a localization of the GCT in the distal femur, a recurrence was seen, whereas the recurrence rate in patients with a localization of the GCT in the proximal tibia was 19**% [9].**

In group 1 (bone cement filling and osteosynthesis), the recurrence rate was 24% (5 out of 21 patients) Further treatment of the recurrence included another curettage and bone cement filling (3 patients), a wide resection (1 patient) and amputation after soft tissue recurrence (1 patient).

In group 2 (cancellous bone filling or curettage alone), the recurrence rate was 52.9% (9 out of 17 patients). Further treatment in this group included curettage and bone cement filling (8 patients) and a wide resection in (1 patient). The difference in recurrence rate was not statistically significant ($p>0.05$).

Gaston, *et al.* [10] reported that curettage with cementation had a lower rate of local recurrence than curettage alone in their study which included 330 patients (171 males and 159 females with a mean age of 32.5 years (13 to 73) treated primarily with intralesional curettage, 84 (25.5%) received adjuvant PMMA. adjuvant cementation was used if the residual bone was deficient or there was an associated fracture.

The current study included one patient with a pathological fracture that was detected preoperatively; and that patient underwent additional screw fixation and autologous bone graft with bone taken from the ilium in addition to calcium phosphate cement (CPC) augmentation and curettage. The other 18 cases were all just filled with CPC after curettage, without any additional internal fixation. There were no complications, including infection, postoperative fracture, instability, and restricted range of motion. Secondary osteoarthritis of the knee joint was detected in a total of 5 patients (26%) at an average of 131 months of follow-up and they were only followed at an outpatient clinic because they experienced no arthritis-related pain. While none of the other 14 patients experienced progression of osteoarthritis secondary to the surgical procedure.

Araki *et al.* [11] study was consistent with ours where they retrospectively evaluated 19 patients who underwent curettage and augmentation with calcium phosphate cement (CPC) for primary GCTB. The tumors were located at the distal aspect of the femur in 12 patients and at the proximal aspect of the tibia in 7 patients. The Campanacci classification was grade I in 3 patients, grade II in 12 patients, and grade III in 4 patients. The study population included 12 women and 7 men. The median follow-up was 131 months (range, 66 to 205months). The median age at the time of the index procedure was 39 years (range, 20 to 63 years). The functional outcome was evaluated with use of the Musculoskeletal Tumor Society (MSTS) score, and the oncological outcome was assessed at the time of the latest follow-up.

Additionally, **Araki *et al.*** [11] had the close results regarding recurrence rate as their oncological assessment revealed that 17 patients were free of oncological disease and only 2 cases had recurrence. Also, similarity in functional outcome occurred with the present study as functional outcomes were excellent in all cases, with an average MSTS score of 29 points (range, 23 to 30 points). The lowest MSTS score (23 points) was observed in the patient who eventually underwent total knee arthroplasty for symptomatic progression of osteoarthritis to Kellgren-Lawrence (KL) grade 3, with MSTS scoring having occurred prior to the arthroplasty procedure.

Tsukamoto *et al.* [12] included a total of 203 patients with a median age of 27.7 years, the median follow-up was 84.2 months. Overall local recurrence rate was 15.3% (31 patients) and the median MSTS score for the patients treated by orthopedic oncology surgeons was 96.7%.

Our result was in contrast to that of **Saikia, *et al.*** [13] who treated 37 patients of Campanacci grade III and Grade II GCT, with a mean follow-up period of 6.5 years (range, 2.5-12 years).

Recurrence was diagnosed when there was progressive lysis of more than 5 mm at the bone-cement interface or if sclerotic rim at the bone-cement interface was absent. The highest rate of local recurrence in the distal radius (n=2/3; 66.7%) followed by distal tibia (n=1/2; 50%), distal femur (n=5/11; 45.5%) and proximal tibia (n=3/13; 23%). Patients with recurrence were treated with secondary procedure like intralesional curettage and recementing (n=8/11; 72.7%) and wide resection (n=3/11; 27.3%). The rate of recurrence was independent of age and sex of the patient.

Post-recurrence follow-up was 2 to 6.5 years (mean, 4.2 years). Re-recurrence was observed following secondary procedure in two cases (n=2/11; 18.1%). Both re-recurrences were following secondary procedure of cementing (n=2/8; 25%). The re-recurrence was detected at 9 and 16 months, respectively after second curettage and cementing. One was treated with curettage and cementing while the

other underwent a wide resection procedure. None of them has shown any further evidence of recurrence till the most recent follow-up. Seven of the 11 recurrence cases gave consent for the inspection of the articular cartilage arthroscopically and no evidence of pathological changes was detected.

Various possibilities exist for increased percentage of recurrence in their study (rate of local recurrence was 34.47%). Many Grade III tumors had cortical break through with massive soft tissue involvement (n=10), where the recurrence rate was found to be 50% (n=5/10). Minimal cortical break with extension/massive tissue involvement indicates more aggressiveness. The study includes a cross-section of all patients who had undergone treatment for GCTs of long bone at their institute rather than being limited to selected cases who had Grade II or less aggressive tumors. This may also explain the much higher recurrence rate in their study [13].

Also, if the cortex was deficient radiologically, the curettage and bone cementing has higher recurrence. It may be because soft tissue infiltration has already taken place at the time of presentation [14].

CONCLUSION

It could be concluded that patients with GCT of the bone at the proximal end of tibia can be treated satisfactorily with curettage and bone cement packing with lower recurrence rate. Cement filling after extended curettage does not increase the recurrence rate and does not induce osteoarthritis, if the continuity of articular cartilage is maintained. Curettage with adjuvants is a feasible first choice treatment option for GCTB, with good oncological outcome and joint preservation. Better MSTS functional results were also observed after extended curettage and bone cement.

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